Journal of the Society of Arts.

FRIDAY, SEPTEMBER 19, 1856.

REGISTRY OF CANDIDATES WHO HAVE OBTAINED CERTIFICATES.

The Council of the Society of Arts have resolved to open a Public Registry for the benefit of employers and the young men who pass with credit the Society's Annual Examinations. The following circular has been issued by the Secretary :—

"Society of Arts, Manufactures, and Commerce,"
Adelphi, London, Sept. 1, 1856.

Sir,—I am instucted to bring under your notice the subjoined recommendation of the Board of Examiners appointed to conduct the Society's Examinations, and confirmed at a recent meeting of the Council of this Society.

"The Board of Examiners are entirely of opinion that a great additional value would be imparted to the Certificates issued by the Society of Arts, and to the prizes awarded, were the Council to open a Public Registry of all those persons who from time to time shall obtain the Society's Certificates, and shall be desirous to procure employment. Through such a Registry the Council would be enabled to afford to employers precise and accurate information—the result of a prolonged and searching inquiry—as to the attainments and intellectual ability of any of their certificated candidates."

The importance of a Registry of this kind, if freely used by the public, can scarcely be overrated. To employers, who may wish to secure the services of intelligent and industrious young men, it will afford a precise and in most cases an unerring* test of the actual attainments and ability of those persons whose names appear on the register. They must all possess a certain amount of industry, intelligence, and acquirement; for no one will be permitted to place his name on the register who shall not have obtained at least one Certificate at the Society's Examinations. The Registry will be so arranged as to give the name, age, place of residence, previous occupation, employer if any, and the subjects in which Certificates have been granted. Employers who take an interest in the progress of National Education, and who desire to encourage habits of self-instruction and of steady application in the young men of England, are invited to avail themselves of the facilities which will be afforded them, free of charge, by the Society of Arts' Registry. Every appointment thus filled will not only have rewarded some industrious and deserving young person, but will stimulate many others to enter on and persevere in a course of patient labour for their self-improvemeut.

Although employers must satisfy themselves of the moral qualities of their candidates, and the Council do not profess to give any guarantee on this head, yet they are of opinion that a young man who must necessarily have devoted to study a large portion of the time at his disposal, often very scant, can scarcely have had much leisure for idle pursuits or vicious indulgences.

I beg to call your attention to the subjoined "Declaration," which has received upwards of five hundred signatures, including those of Manufacturers, Merchants, Bankers, Ironmasters, Shipbuilders, Railway Companies, Insurance Companies, and various other firms, &c.; as also to furnish you with a list* of those persons who obtained Certificates at the Society's Examinations held on the 10th, 11th, 12th, and 13th, of June last, at the Society's house in the Adelphi, with the subjects in which Certifiates and prizes were awarded to them. The Council desire the expression of your approval to a plan, which, if generally supported, may become a great national benefit.

I have the honour to be your very obedient servant,
P. LE NEVE FOSTER,
Secretary.

DECLARATION.

"We, the undersigned, having considered the Memorandum of the Council of the Society of Arts, and the plan therein set forth, for examining and granting certificates to the students of classes for instruction in the Literary and Scientific Institutions, Mechanics' Institutes, Athenæums, and other similar bodies in union with the said Society, do hereby declare that we desire to promote the success of the said plan, and are prepared *to regard as testimonials worthy of credit* such Certificates as may be awarded in conformity thereto."

METHYLATED SPIRIT.

A Report has been addressed to the Commissioners of Inland Revenue, by Professors Graham, Hofmann, and Redwood, on the supply of Spirit of Wine, free from duty, for use in the arts and manufactures, without injury to the revenue. In order to carry out this object it was necessary that the spirit should be first rendered unfit for human consumption, and that after being thus treated it should still be so pure as to be generally available for use in the arts and manufactures, without being capable of being made palatable by any simple process of rectification or otherwise. It also seemed important that no poisonous properties should be communicated to it.

Experiments were made with various volatile substances, which seemed adapted for mixing with the alcohol in order to fulfil these conditions, but the greater number were found unsuitable upon a close consideration or actual trial of their properties. Among these may be mentioned sulphide of ethyl and various volatile oils and ethers, which are too easily separated by distillation. The liquid distilled from caoutchouc, and known as caoutchicene, seemed to obviate this objection to a great extent, but the intense and disagreeable odour communicated to the spirit would have considerably limited its applications. The report then proceeds in the following words to give an account of the substance which has been employed with success :—

"Our attention had been particularly directed to wood naphtha (crude pyroxylic or methylic spirit), as the substance to be added to alcohol, by the previous experiments of Mr. G. Phillips and of Dr. Hofmann on the use of that liquid. The application of crude wood-naphtha depends partly upon the empyreumatic oils which it contains, and partly upon the methylic spirit and other substances miscible with water, which constitute the mass of the liquid. It was necessary to examine separately the influence of these two classes of constituents, and first of the empyreumatic oils.

"In one series of experiments, a specimen of the oils which had been separated from wood-spirit in the process of purifying that liquid, was used as the flavouring substance. Two per cent. of these oils were dissolved in spirits of wine. This mixed spirit had the strong

* It has long been known that the system of granting appointments upon the faith of testimonials is a bad one. Carelessness—what is called good nature, but which would be more justly described as a want of principle—private interest—the desire to repay an obligation or get rid of a bore—these are the prolific parents of recommendations which ought never to have been given, but against which it is extremely difficult for the dispensers of patronage to guard themselves.—*Athenæum*, p. 1021, *Aug.* 16, 1856.

* For this list see No. 188 of the *Journal*.

characteristic odour of crude wood-naphtha, became milky when mixed with water, and was highly unpalatable.

"When this mixed spirit without any addition was simply distilled by the heat of a water-bath, a small quantity of a dark-brown tarry matter was left behind in the retort, and the proportion of oils in the distilled spirit was greatly reduced. This mixed spirit appeared to be further purified when distilled from anhydrous sulphate of copper, from the protosulphate of iron, or from persulphate of iron. But none of those distillates was potable, and all became turbid with water. The flavour of the same mixed spirit was improved by distillation with one-eighth of its weight of sulphuric acid, but the liquid was still not potable. When the last distillate was again rectified from one-twentieth of its weight in potash, the rank odour of the oils disappeared in a great measure, the odour now retained resembling that of benzole. An attempt was made to remove the odour last described, by diluting the liquid with water, and passing it in the state of vapour over animal charcoal, but the liquid still retained the benzole odour, and was precipitated by water.

"The greatest amount of purification was obtained by distillation from potash or lime, the alkali keeping back the creosote; but the mixed spirit still retained the tarry smell of benzole, and was turbid with water. When the mixed spirit, so far purified by means of alkali, was diluted with water and again distilled, the first half of the new distillate was turbid with water, and even formed a layer of oil on the surface. But the second half of the distillate did not become turbid with water, showing that the benzole product comes off first. This last portion of the alcohol appearing to be restored to a fair degree of purity, it became doubtful whether much dependence could be placed upon the oils of wood-naphtha, for the purpose of mixing, apart from the methylic spirit of the naphtha. An experiment was made with pure benzole itself, mixing the proportion of one part of benzole to ninety-nine parts of strong alcohol. A considerable portion of benzole was separated from this mixture by dilution with water, the benzole forming an oily film on the surface of the liquid. The liquid, however, continued milky, and retained a strong odour of benzole. When this mixed spirit was diluted with three times its volume of water, and slowly rectified, the first half of the distillate contained much benzole, and became milky with water, while the second half of the distillate did not become turbid with water, and appeared to contain very little benzole. This result affords a very strong presumption that benzole is removable by rectification from alcohol when diluted with water.

"Three additional and still more extensive series of experiments were made by means of different varieties of crude wood naphtha, as this substance varies considerably in composition. Two of the varieties were procured from Messrs. Turnbull and Co., of Glasgow, one of which was described as 'of full strength, but concentrated without destroying the oils;' the other described as taken 'at an earlier stage of the process, half strength, and containing more oils than the last.' The third material operated upon was a mixture of strong alcohol with five per cent. of crude naphtha, prepared at the laboratory of Inland Revenue by Mr. Phillips. But after what has been already said it is unnecessary to enter into the details of those experiments, as the results were similar to the first series. The oils were, in a great measure, removed from the mixed spirit by simple distillation, or by distillation from potash, and the distilled spirit was chiefly characterised by the taste and comparatively mild odour of methylic spirit or pure wood-spirit. The specimens became as little offensive as alcohol mixed with Turnbull's purified wood-naphtha; and there appeared, therefore, to be no great advantage in using the crude naphtha for mixing in reference to a purer wood-spirit. The question reduced itself to the applicability of pure wood-naphtha for the object in view.

"The wood-naphtha hereafter used for mixing with alcohol was of the comparatively pure quality in which it is supplied to the public by Messrs. Turnbull and Co., at the price of 8s. 6d. per gallon. This wood-naphtha was nearly colourless; it mixed with water without becoming turbid in the least degree, and contained no more than a small trace of the oils which gave a rank and repulsive odour to many species of wood-naphtha. The odour of this purified wood-naphtha was not disagreeable, although well marked and characteristic, being due principally to methylic spirit. The specific gravity of this naphtha was 0·815, and its boiling point 151° Fahr. When thoroughly dehydrated by being distilled three times from half its weight of anhydrous sulphate of copper, one gallon of the liquid gave by fractional distillation the following series of liquids, each amounting to about a pint:—

1st distillate	of sp. gr.	0·8067	; boiling point	143.6°F.
2nd	,,	0·8047	,,	143·3° ,,
3rd	,,	0·8031	,,	146·5° ,,
4th	,,	0·8208	,,	146·5° ,,
5th	,,	0·8016	,,	148° ,,
6th	,,	0·8008	,,	150° ,,
7th	,,	0·8009	,,	151° ,,
8th	,,	0·8015	,,	151° ,,

Fractions 1 and 2 distilled again together from anhydrous sulphate of copper, retained the low boiling point 143·5°, and had the mean density 0·8057, which is a liquid possessing the lowest boiling point that has been assigned to methylic spirit, but with a somewhat higher specific gravity, the specific gravity of pure methylic spirit being about 0·800. None of the fractional portions appear to be a single substance. The methylic spirit is probably accompanied in the earlier fractions with acetone of sp. gr. 0·792 and boiling at 132·8°, and acetate of methyl of sp. gr. 0·908 and boiling at 144°; while some third liquid, of which the nature is unknown, must be present to impart the high boiling point combined with a low specific gravity which distinguishes the latter fractions of the distillate.

The presence of five per cent. of this purified wood-naphtha in strong alcohol is easily recognised by its taste and odour, and is more than sufficient to render spirit unsaleable as a beverage, as has been ascertained upon good authority. At the same time the odour of the mixed spirit on evaporating in the air is by no means offensive. In solvent power such a mixed spirit is indistinguishable from pure alcohol; and varnishes made by means of it dry readily and acquire no odour or peculiar character from the menstruum. Farther, no practicable means of separating the methylic spirit again and recovering the spirit of wine in a state of purity and suitable as a beverage, appear to exist; while the substance which destroys the potability of the mixed spirit, without impairing its value for many useful purposes, is not itself poisonous or unwholesome, wood-naphtha, as is well known, having been used to some extent in medicine. The purified wood-naphtha appears indeed to be singularly well adapted for the preparation of a mixed spirit such as the government desires to supply duty-free to manufacturers. At the same time a mixed spirit containing 10 per cent. of the purified wood-naphtha appears to be preferable to a five per cent. mixture, from the great facility of recognising the wood-naphtha in the larger proportion, particularly when disguised by the presence of other volatile and odorous substances. A ten per cent. mixture might therefore be issued in the first instance, and the proportion of wood-naphtha be reduced at a later period if it was found that the change could be made with safety to the revenue. It is accordingly a ten per cent. mixture which we have had tested for the various useful applications of alcohol, because if this

mixture was found to meet the requirements of trade, the suitability for the same purposes of any mixture containing a less proportion of wood-naphtha might be safely assumed.

"Although wood-naphtha (methylic spirit) and alcohol are of unequal volatility, there being a difference of about thirty degrees between their boiling points, yet no sensible separation of these liquids can be effected by distillation. Both the 5 and 10 per cent. mixtures described were submitted to fractional distillation; but wood-naphtha was found in all the fractions. Even the last eighth portion of the 5 per cent. mixture, which was not distilled over, but was left behind in the retort, contained abundance of wood-naphtha, the more volatile constituent. In another experiment, to be described in the sequel, rectification repeated several times failed equally to eliminate the smallest portion of pure methylic spirit from the mixed spirit. The reason of this is, that alcohol which boils at the higher temperature has a denser vapour than methylic spirit, in the proportion of 1·600 to 1·125. The less volume of alcohol vapour which distils over at the boiling point of the mixed spirit is compensated for by the greater weight of that vapour, so that the proportion between the constituents of the mixed spirit appears to be little if at all disturbed during the progress of the distillation.

"The similarity in chemical constitution of methylic spirit and spirit of wine, both being alcohols, is attended with a remarkable analogy in properties between the two substances, which appears to render their separation by chemical means also a problem of great, if not insuperable, difficulty.

"Methylic spirit forms a solid crystalline compound with chloride of calcium,—a property which is taken advantage of in purifying methylic spirit, for scientific purposes, from the other liquids by which it is accompanied in wood-naphtha. Our mixed spirit being first carefully dehydrated by means of sulphate of copper, and reduced to a specific gravity of 0·801, was then mixed with chloride of calcium, in excess, so as to form a thin paste, and distilled by a water-bath heat. Methylic spirit was easily discernible by its odour in the distillate which came over; so that the presence of ordinary alcohol in a large relative proportion appears to prevent the combination of methylic alcohol with chloride of calcium, or to decompose such a compound when formed; for ordinary alcohol, as well as methylic alcohol, has a considerable affinity for the salt in question. When water was subsequently added to the chloride of calcium nearly dry in the retort, and the heat renewed, a liquid came over which possessed a peculiar and disagreeable odour, but appeared to be chiefly composed of ordinary alcohol. This liquid should have been methylic spirit if the experiment of separation had been successful.

"The attempt was also made to purify the alcohol of our mixed spirit from its accompanying methylic spirit, by passing the vapour of the two liquids through a long glass tube containing fragments of chloride of calcium, which was kept at a temperature of 212° during the experiment. No absorption, however, of the methylic spirit by the chloride of calcium occurred, but the salt remained unaltered, and the alcohol distilled over and condensed with its original proportion of methylic spirit.

"Several experiments were also made on the oxidation of the mixed spirit by means of various proportions of the mixture of bichromate of potash and sulphuric acid, with the view of oxidising and removing the methylic spirit, but without success. The oxidation products were acetic acid and formic acid, accompanied by much aldehyde, and indicated the decomposition of the alcohol as well as of the methylic spirit.

"Sulphuric acid is very useful for discovering the presence of common alcohol when mixed with wood-spirit from the ready production of ordinary sulphuric ether. But for the converse problem of separating a small proportion of wood-spirit from a large proportion of alcohol, sulphuric acid appeared to be wholly inapplicable.

"Oxalic acid employed to etherise the mixed spirit seemed at first to promise better results, as the methylic oxalic ether appeared to form more easily than the corresponding ethylic ether. After the cohobation of the dehydrated mixed spirit with oxalic acid for several hours, the liquid which came over on distilling was alcohol with the proportion of methylic spirit apparently considerably reduced. This alcohol always contained portions of the oxalic ethers, and was liable to become acid from the gradual decomposition of these ethers. The flavour of the methylic spirit, which is at first covered by a rum-like flavour of these ethers, would no doubt come out with time, and prove, as usual, highly disagreeable. No economical process for the purification of the mixed spirit could, we believe, be founded on the action of oxalic acid.

"The conclusion from much investigation is, that the removal of wood-naphtha from the 10 per cent. mixed spirit, and the restoration of its potability by any simple and economical process is a most unlikely occurrence. We apprehend no danger whatever to the revenue from this source. The mixture of spirits of wine with *ten* per cent. of purified wood-naphtha or methylic spirit, which we recommend, may be designated *methylated spirit*, for convenience.

"The quantity of wood-naphtha which can be commanded appears to be amply sufficient for the new contemplated application of that substance. We are indebted to Mr. John Turnbull for his valuable opinion on this point. 'My calculation regarding wood-spirit,' that gentleman states, 'is a produce of two gallons and a half from a ton of average dry wood, and the production of the United Kingdom amounts annually to 66,000 gallons. This I take as the proceeds of nineteen manufacturers of pyroligneous acid; although you must receive it as a rough guess, still I believe it is not very far from the truth.' Much wood-naphtha is also attracted to this country from the Continent, owing to the high price which that liquid obtains here as a substitute for alcohol.

"We have been favoured with the opinion of Mr. G. Smith, of Whitechapel, one of the most extensive London distillers, on the application of our methylated spirit as a beverage. He pronounces the methylated spirit to be quite unfit for the use of the rectifier. He believes that publicans would never use such a spirit for mixing with their liquors, even in a small proportion. A mixture of gin with one-eighth part of the methylated spirit was found to be nauseous and unpalatable. In gin mixed with one-sixteenth of methylated spirit, the flavour of the latter was still very strongly marked. In gin with one part of methylated spirit in thirty-two, the flavour of the methylated spirit became faint, but it was still perceptible in a mixture of one to sixty-four. The largest proportion of the methylated spirit which it was thought a publican might venture upon adding to his gin was one in thirty-two. Now, the saving to him would be the same fraction of the spirit duty, or proportion of 6s. 2d. per gallon, the duty on spirits of the strength of gin—that is, a profit of 2¼d. per gallon. So small a profit would be no compensation for the deterioration in the quality of the gin. The disagreeable odour of the methylic spirit is brought out strongly on mixing the gin with hot water.

"The consumption of sweetened and highly-flavoured cordials appears to be greatly inferior to that of gin; a publican in large business, who may retail 1,200 gallons of gin per month, not disposing of more than ten or twelve gallons of cordials in the same time. The substances chiefly used in flavouring cordials are carraways, cloves, and aniseed. The methylated spirit could not be used for any of these liquors. Indeed, from their being generally made use of to give an extempore flavour to gin at the option of the customer,

more than usual attention must be paid to their own purity of flavour.

"The flavour of brandy is too delicate to be tampered with by the addition of the smallest proportion of methylated spirit. The addition of the latter substance to whiskey would require to be guarded against, from the predilection of the consumers of that spirit to a smoky flavour. An experiment has been related to us, in which methylic spirit was employed for the sake of its flavour by a Scotch distiller, and mixed with spirits in the minute proportion of one gallon to 1,000 gallons. The flavour, although not objected to in the whisky when newly mixed, became rank and disagreeable in the course of two months. The mixing of methylated spirit with that low quality of rum known as Leeward Islands rum, is also to be apprehended, from the great impurity of that spirit, which would render any additional contamination less obvious to the palate. But when the liquid is deliberately examined, the presence of methylic spirit could not escape detection.

(*To be continued.*)

THE MANUFACTURE OF IRON WITHOUT FUEL.

In the last number of the *Journal*, brief reference was made to certain patents bearing on Mr. Bessemer's invention, and the importance of the subject renders it desirable to give them at length as well as the substance of another patent granted to Reuben Plant. The date and title of Plant's patent are as follows:—

Letters patent to Reuben Plant, of Holly-hall Colliery, near Dudley, in the county of Worcester, coalmaster, for "Improvements in Making Bar or Wrought Iron." Patent dated July 18, 1849. The invention is for a puddling furnace of the ordinary dimensions; there should be three lines of tuyeres across the top of the furnace, each line consisting of three tuyeres, and each tuyere being one inch in diameter; the line furthest from the chimney should be the tuyeres for the blast, and the other two lines the steam tuyeres for the puddling and preparatory chambers. The blast is to be at a pressure of one pound and upwards to the square inch, and the steam is to be used at a pressure of ten pounds and upwards on the square inch. The blast should be introduced at the top of the puddling chamber, just behind the fire-bridge, in a slanting direction, so as to drive the flame, as it enters the puddling chamber, down upon the whole surface of the iron. The steam from the tuyeres should be introduced as nearly as possible at the same place, so as to fall in like manner at once upon the whole surface of the iron in the puddling chamber.

It is stated that by means of the above arrangements the heat of the puddling and preparatory chambers can be regulated with great nicety without the employment of the damper usually inserted in the chimney of a puddling furnace. When the metal in the puddling chamber is melted, the blast is to be shut off, and steam introduced through the tuyeres until the iron boils. The steam is then to be turned off, and the blast is again brought into action till the iron appears above the cinder. The blast should now be shut off, and the iron finished by the ordinary draught in the usual manner, or the heat may be raised and lowered, as required, in the way above described. The damper over the fire-bridge is to be raised and lowered from time to time, to increase or lower the heat of the puddling chamber, as may be found requisite.

The patentee says he does not claim the application alone either of blast or steam in the working of an ordinary puddling or other furnace; nor does he confine himself to the details shown and described above, so long as the peculiar character of his improvement be maintained. He claims as his improvements in making bar or wrought iron the use of hot or cold blasts with steam jets, and hot or cold blasts with the damper described, or with the ordinary damper in the draught of the chimney, to regulate the heat in the said puddling chamber; and he claims the use of hot or cold blasts and steam jets, and steam jets themselves, to regulate the heat in the said puddling and preparatory chambers respectively, instead of the ordinary damper.

James Nasmyth's patent is granted for "An improvement in the puddling of iron," and is dated the 4th of May, 1854. The specification runs as follows:—

"In order that the nature of my invention may be more clearly understood, it may be well to explain the object and present mode of effecting the operation which in the manufacture of iron is termed 'puddling.' With this view I may premise that cast iron owes its distinctive properties from wrought iron chiefly to the presence of carbon existing in combination in some peculiar condition with the iron. It also contains silex, sulphur, and other impurities, from which wrought iron is in great degree free. To convert cast iron into wrought iron, it is requisite to free the iron more or less from the carbon which it contains, and in doing so it is also desirable to drive off the other impurities combined or mixed with the iron. One process by which this object is accomplished is termed 'puddling.' It consists, in the first place, in raking backwards and forwards molten cast iron in a furnace, the tool or instrument employed to effect the raking being called a 'rabble.' This raking backwards and forwards of the molten cast iron puts it into a state of agitation, and thus successively exposes fresh surfaces of the molten metal to the action of a current of atmospheric air, which the draft of the furnace carries over its surface. The carbon of the cast iron thus becomes oxidated, and passes off in the condition of carbonic acid and carbonic oxide. On the continuance of this agitating action for a sufficient length of time, the cast iron begins to lose its fluidity to a certain extent and becomes thick and pasty, shortly after which granulated particles of wrought or malleable iron appear in the scoria. These particles, which the puddling and decarbonizing process just described has converted, are afterwards formed into balls and brought out of the furnace, to be hammered or squeezed into blooms or bars in the usual way. The object, therefore, of the process termed 'puddling' is to remove the carbon from cast iron, and so convert it into malleable or wrought iron; and, as is well known, the operation is a very laborious one, requiring long and violent manual exertion with little intermission. It will, therefore, be evident, that if with due economy the oxidation of the carbon of the molten iron can be expedited without injury to the quality of the wrought iron resulting from the operation, an important improvement will be effected in the puddling of iron. Now, my invention relates to a process of puddling iron, whereby not only will the disengagement of the carbon from the molten metal be greatly expedited, but the quality of the iron will also be considerably improved. In carrying out this invention I subject the molten cast iron in the puddling or refining furnace to the action of a current or currents of steam, introduced as nearly as practicable to the lowest portion of the molten iron, and thence diffused upwards, so as not only mechanically to agitate the molten iron, and thereby keep exposing fresh surfaces of the iron to the oxygen contained in the atmosphere passing through the furnace, but also, when brought into contact with the incandescent iron, to be reduced to its elements and yield oxygen, which will chemically combine with the carbon of the iron as well as with the sulphur or other oxidizable substances of the iron with which it may come into contact and have affinity, and thereby deprive the iron of those impurities, whilst the other component of the steam simultaneously liberated, namely, hydrogen, is free to combine with any sulphur present in the furnace, whether as an ingredient in the iron or as a product of com-

bustion of the fuel employed for heating the iron, and thus substances very prejudicial to the quality of the iron will be removed or prevented from combining therewith, whilst, at the same time, the operation will be materially expedited. * * * *

"The mode of operating with this apparatus is as follows:—The metal having been brought in the ordinary manner to a molten state, the steam pipe is introduced by the attendant through the rabble hole into the fluid metal, its orifice being submerged or kept below the surface of the metal. He then moves the pipe about in the metal like a rabble or rake, and thereby causes the steam to escape into the metal at all parts of the bed of the furnace. By thus distributing the steam throughout the body of molten metal, the steam will, as above stated, be resolved into its elements immediately on coming in contact with the metal, and will cause the upheaving of the metal, and effect a rapid and continuous disturbance thereof, and its components will enter into chemical combination with more or less of the carbon and sulphur present in the iron.

"When the metal has been brought into a condition sufficiently decarbonized or thickened, as to which the judgment of the workman will be his guide, the steam pipe is to be removed, and the ordinary method is adopted for the purpose of gathering the metal into balls, preparatory to the removal of the same from the furnace to the tilt hammer or rolls. By these means the operation of puddling is rendered much easier to the workman, and more uniform and certain in its results, whilst the time in which it is effected is shortened, and the purity, toughness, and strength of the iron resulting are increased in a remarkable degree."

The patent of Joseph Gilbert Martien, of Newark, New Jersey, United States of America is granted "for the invention of improvements in the manufacture of iron and steel," and is dated September 15, 1855. The specification is as follows:—"This invention has for its object the purifying of iron when in the liquid state from a blast furnace, or from a refinery furnace, by means of atmospheric air, or of steam, or of vapour of water, applied below, and so that it may rise up among, and completely penetrate and search every part of the metal prior to the congelation, or before such liquid metal is allowed to set, or prior to its being run into a reverberatory furnace, in order to its being subjected to puddling, by which means the manufacture of wrought iron by puddling such purified cast iron and also the manufacture of steel therefrom in the ordinary manner are improved.

"In carrying out my invention, in place of allowing the melted iron from a blast furnace simply to flow in the ordinary gutter or channel to the bed or mounds, or to refinery or puddling furnaces in the ordinary manner, I employ channels or gutters, so arranged that numerous streams of air, or of steam, or of vapour of water, may be passed through and among the melted metal as it flows from a blast furnace.

"I prefer, in carrying out my invention, that the ordinary process of refining iron by the use of a refinery furnace should be dispensed with, and that the purifying of the iron should be accomplished by subjecting the melted iron from a blast furnace before it is allowed to congeal, to the action of streams of air or of steam passed up through and among the melted metal; at the same time I would state that where it is preferred by others still to resort to the ordinary process by remelting, then my invention is to be applied to the melted metal as it flows from such furnace to a bed or moulds, in like manner to what I will now describe as applicable to a blast furnace. The channel or gutter employed may be of any suitable material, but I prefer it to be of cast-iron, the bottom part being made hollow to receive steam, or air, or both. This gutter is perforated with numerous holes, which I prefer to be inclined, so that the streams of air or steam may be forced through the melted metal (as it flows along the gutter) in an oblique direction, but, by preference, in the direction in which the metal flows. This, however, is not essential, as the streams of air or steam may be passed directly up or through the melted metal; or the holes may be inclined in the opposite direction, so as to oppose the flow of the melted metal. When hot blast or cold blast is used, I prefer to connect the hollow bottom of the gutter with the air pipes used for supplying the blast, and, when steam is employed, I connect the hollow bottom of the gutter with the boiler used. By this means the air or steam introduced in the hollow bottom of the gutter below the metal will rise up, and be forced through it in numerous streams; or, in place of the gutter being the means of applying streams of air below the fluid iron as it comes from a blast furnace, the moulds or beds into which the iron is received may be arranged with means for introducing air or steam below the melted metal, and to divide such air or steam into numerous streams, so that the iron may be purified thereby after it has come from the blast furnace, and before the congelation of the liquid metal takes place.

"The gutter or channel above mentioned may be covered over for any part of its length, and it may be arranged in a suitable manner to admit of heat being applied to the metal therein; and such is also the case with respect to the moulds or bed in order that heat may be continued to the fluid metal after it has left the blast furnace, and while the process above described of purifying the metal is going on. The iron thus purified may be allowed to cool in the moulds, or it may run from the gutter, channel, or receiver, into a reverberatory or suitable furnace, to be highly heated therein, and may be puddled in the ordinary manner.

"I would remark that I am aware that it has before been proposed to use streams of steam in puddling and refinery furnaces in such a manner as to come in contact with the surface of the melted metal therein; and it has also been proposed to introduce steam below melted iron when puddling the same. And I mention these cases in order to state that I make no claim thereto; but what I claim is, the purifying iron from a blast furnace or a refinery furnace while still in a melted state, as herein described."

Mr. Bessemer has taken out several patents relating to iron and steel, respectively dated January 4, 1856; February 12, 1856; March 15, 1856; May 31, 1856; August 19, 1856. The one dated in February is specified, but the specification is not yet printed. The subsequent patents are not specified.

The January patent is granted to Henry Bessemer, of Queen-street-place, New Cannon-street, in the city of London, "for improvements in the manufacture of iron and steel." In the specification he says:—

"Now the object of my present invention is the more perfect and complete refinement of the iron, whereby it gradually loses the properties common to pig or crude iron, and acquires the properties of cast steel, or of pure or decarbonized iron, while it still preserves such a state of fluidity as will admit of its being cast into ingots or other desired forms or articles by the process of founding; for which purpose I expose the iron in a more divided or extended form to the intense heat of the furnace or furnaces hereinafter described, and to the oxidizing action of a blast of air, by keeping such fluid metal in motion and continually bringing fresh portions of it in contact with oxygen and with the intensely ignited fuel, or with the highly heated interior surface of the furnace, the metal being thus kept in a fluid state until the desired amount of decarbonization or refinement is arrived at.

"The iron to be used for the purposes of my present invention may be conveyed by a gutter in a fluid state direct from the smelting furnace, where it has been obtained from the ore, and be allowed to flow into the improved furnace or furnaces hereinafter described, or it may be obtained from any convenient form of remelting furnace, or the iron may undergo a previous partial refinement in the old or in any convenient way; and

which iron I proceed to complete the refinement of in any one of the following modifications of apparatus.

"Having thus described my invention, and the manner in which the same may be carried into effect, I desire it to be understood that I do not confine myself to the precise details herein specified, provided that the peculiar character of my invention be retained; but what I do claim, firstly, is the conversion of fluid crude iron into steel or into malleable iron by exposing the metal to the decarbonizing action of currents of air in furnaces, through which the metal is allowed to fall for that purpose. And also, in the manufacture of iron and steel, the alternate rising and lowering of two furnaces, so as to allow the fluid metal to flow from one to the other in the manner, and for the purposes, before described.

"Secondly—I claim, in manufacturing malleable iron and steel from crude iron while still in a fluid state, the use of revolving furnaces, having apparatus in the interior for the purpose of elevating portions of the metal, and allowing it again to fall in streams or showers when exposed to the action of currents of air passing through the furnace.

"Thirdly—I claim, in the manufacture of iron and steel, the suspension of the fluid metal in the furnace by means of centrifugal force generated by the rotation of such furnace, and the forcing into, through, or upon the fluid metal so suspended currents of air or steam.

"Lastly—I claim the manufacture of bars, rods, or plates of steel by the cementation of bars or rods of malleable iron that have been obtained by the direct conversion of crude iron into malleable iron, and while still in a fluid state cast in suitable moulds."

ON TONNAGE REGISTRATION AND MERCANTILE STEAM TRANSPORT.

The following article has been received from the Editor of the *Mechanics' Magazine*:—

It would seem that the object for which Mr. Atherton has been long agitating has now assumed something of a practical form, as a Committee has been appointed by the British Association for the Advancement of Science to consider the question of measurement of ships for tonnage, and other questions of a cognate character. We do not quarrel with the composition of that Committee, for along with the names of Messrs. Atherton, Peake, and Henderson, who have committed themselves to certain views, we observe the names of other gentlemen, some of them eminent for scientific ability, and others for skill as practical shipbuilders, which holds out a prospect of impartiality in the conduct of its deliberations. We would venture to remind the Committee so appointed, that a duty of no small responsibility is intrusted to them; for it is in their power, according to the spirit and judgment displayed by them in the exercise of their functions, either to further or seriously damage the cause of science as connected with the art of ship-building. Those members of the Committee especially who represent mainly the scientific element in its composition, would do well to bear in mind, that the cause of science would be damaged rather than served by any attempt to attain a scientific object, irrespective of the important modifications which the legitimate interests of shipbuilders and shipowners demand; and that a moderate advance, if attainable, is more really useful than the most *perfect system* which is practically unattainable.

The first thing the Committee will have to do, is to obtain a clear insight into the question as it at present stands, and the real objects proposed for its consideration.

It was with this view that Mr. Atherton laid before the British Association the paper which we published in Numbers 1724 and 1735 of our Magazine, and we now propose to give a short *resumé* of these objects for the benefit of our readers.

First, then, we must congratulate Mr. Atherton on the greatly improved tone of his observations as laid before the British Association, compared with his paper read before the Society of Arts, on May 16, 1855, and January 16, 1856. That exuberance of philippic in which Mr. Atherton revelled in these two extraordinary documents, has been happily submitted to the healthy discipline of the pruning knife, and the weak points of his previous suggestions are carefully kept out of sight. We can indeed clearly trace throughout his last volume the wholesome effects of our articles published in April, May, and June last, and we are convinced that Mr. Atherton is now in a much safer path for the securing of an impartial and unimpassioned consideration of the scientific features of naval architecture and steam transport economy, than he was after his indiscriminate attack on the Mercantile Shipping Act of 1854, in January last.

The questions to be considered by the Committee of the British Association are twofold:—

First, the defects of the present system of registration of tonnage and of steam power.

Secondly, the best mode of applying a remedy for these defects.

Now, with regard to the first of these points, Mr. Atherton is more successful than he is in the second. It is always easier to detect defects than it is to raise a faultless construction. In his observations on tonnage registration, laid before the British Association, Mr. Atherton carefully separates the scientific from the fiscal view of this question, and herein we think he has acted wisely. In summing up the objects which he considers would be served by his paper read before the Society of Arts in January, he says: "By this paper I brought forward certain suggestions for public consideration and discussion, with a view to our official registration of shipping being rendered more comprehensive for the fulfilment of the various useful purposes to which statistical registration, if complete, would undoubtedly conduce in a scientific point of view, *irrespectively of merely fiscal objects.*"

We rejoice to find that, in accordance with our suggestions, Mr. Atherton now brings his position forward, as *in addition to, not subversive of*, the tonnage registration of the Act of 1854. Allowing, therefore, the measurement for fiscal purposes to remain on its present basis, it will be for the Committee to consider whether the interests of the public do not demand the enactment of a further registration *solely* with a view to scientific objects.

Some definite displacement of a vessel, involving the settlement of the whole weight when fully equipped for sea, is a necessary datum for any scientific inquiry. It may then be a question worthy of consideration, whether the constructor of every vessel may not be required to furnish to the Board of Trade, for the purpose of registration, what he designs to be the vessel's load displacement, which, in all probability, will not be practically either much exceeded or much fallen short of.

It appears, from Fincham's "History of Naval Architecture," as Mr. Atherton has several times reminded us, that in vessels of war the constructor always fixes and calculates the load displacement; and there seems no reason why this course should not be pursued with regard to merchant ships.

It is a further and a very different question whether the owners of ships should by law be prohibited from loading their vessels beyond this load displacement. It would be better, in our opinion, to keep this part of the question entirely separate from that which bears a scientific aspect. While shipbuilders and shipowners might, and probably would, resent any attempt to fix by legislative enactment the exact limit to which vessels *might* in any case be loaded, we do not anticipate any

great repugnance on their part to register what may be taken as the mean fair load of the ship, which is all that in a scientific point of view is of importance. It is probably the case, as Mr. Atherton observes, that there is some little ambiguity at present as regards the term *tonnage*. The measurements under the several acts of 1733, 1833, and 1856, are essentially different; but then it must be borne in mind, that only the two latter of these have any reference whatever to the *registered* tonnage of ships; the former has only been preserved to enable persons interested in shipping to form *some idea* of the size of a vessel. As we have said on a former occasion, no legislative enactments can be devised to protect the buyers of ships from the losses incident to want of common sense and common experience. There must be something to learn in every trade, and we are confident that shipowners and shipbuilders laugh at the idea of persons engaged in the act of buying and selling ships professionally being confused between the several meanings which the term tonnage may bear. No person has a right—morally, of course, we mean—to engage in transactions of this kind, unless he is acquainted with the technicalities of the trade, any more than a person has a right to deal in drugs unless he knows the difference between Epsom salts and strychnine. The shipping interests require no protection of this kind, nor can they be expected to receive without suspicion specious offers of protection which they have never asked for, and which they must imagine cloak some ulterior objects which bode them no good. *Timeo Danaos et dona ferentes.*

A knowledge, however, of the weight of cargo *designed* to be carried by each ship, being the difference of the constructor's registered load displacement and light displacement (if it should please the legislature to require such registration), would supply all the information that could be fairly required for statistical purposes.

So much for the defects of the law as regards tonnage registration.

It seems, however, that the registration or calculation of horse-power for mercantile purposes is equally defective. Mr. Atherton, we think, has fully succeeded in establishing this part of the case. The nominal horse-power of an engine gives no indication whatever of the real power to which it can work, for while some marine engines will work only up to twice, some will work to four times the nominal power. It is, therefore, evident that from a knowledge of the nominal horse-power of an engine, no inference can be drawn of it as to its efficiency. To test the value of a vessel propelled by steam in a mercantile point of view, we require to know the *weight* propelled and the power actually exerted in propelling it, and also the *speed* at which it is moved. Hence, it will be for the Committee to consider, whether it would not be for the public advantage, that some more efficient mode of estimating the real power of an engine is not a desideratum, which the legislature may fairly be called upon to supply.

But although we agree with Mr. Atherton, that in a scientific point of view, a more correct mode of estimating horse power is required, we are by no means convinced that the competition amongst engine makers to produce engines which under the smallest possible compass shall give the greatest power, has not been attended with advantages greatly counterbalancing the admitted defects. So far from believing that every fresh vessel of improved form and steam power application only benefits the owner, by giving him the same freight which the vessel of bad form is obliged to charge for the indemnification of the owner, we believe, on the contrary, that the advent of every such vessel tends to lower freights; not perhaps to such a degree as would be the case were none but vessels of good type in the field, but so as to give the public a good share of the advantages resulting from the adoption of good types of build and efficient adaptation of steam power, and so as in a moderate number of years materially to lower the average freight charge for every ship. It is impossible that the average freight should be that of the vessel of the newest and most improved type; all that may be fairly demanded is, that in order to compete with such a vessel, which for the interests of the owner would carry cargo at a lower freight than other ships, the builder must construct all new vessels on *improved*, and not on bad, or even indifferent lines.

This, we believe, to be the history of the great improvements which have undoubtedly been made in mercantile steam shipping of late years. And it is, we believe, doubtful whether under the present system the public interest has not been consulted as efficiently as though "the statistical grindstone" had been as perfect a machine as possible. At all events, we think Mr. Atherton has somewhat overstated his argument in this part of his case.

We do not purpose entering here upon an examination of Mr. Atherton's arithmetical calculations, and of the formula on which those calculations are made. We are content to allow that, without being strictly in accordance with theory, the formula in question is practically sufficiently well adapted for the purpose, and that Mr. Atherton's calculations are not far from the mark.

That there are such *deficiences* in the registration of tonnage and horse power as to render all scientific inferences drawn from these data valueless, must be admitted. If it is advisable to enforce by legislative enactment a remedy for these defects, the next question, and that one of no small difficulty and delicacy for the Committee of the British Association to consider, will be in what form can that remedy be best supplied? Mr. Atherton, in his previous paper and essays on this subject, has suggested remedies which he has formally laid before the Committee. We have so lately examined the value of his improved registry for tonnage, that we do not think it necessary to enlarge on that topic now. Suffice it to say, that the registered load displacement, to serve every scientific purpose, must be as accurately calculated as the most approved modes of approximation will allow: and, as we have fully shown, Mr. Atherton's proposed method is a signal failure, as far as regards this most important element.

To remedy the other defects in the marine horse power registration, Mr. Atherton simply proposes to substitute the unit of 100,000lbs. raised 1 foot high per minute for that of 33,000lbs. so raised. The particular unit of 100,000 is fixed upon, because it appears that the real horse power developed varies betweeu two and four times the nominal power.

But, how would the adoption of this new unit bring the nominal and real power into complete harmony. Still the nominal power of some engines would be 33 per cent. less, and others 33 per cent. more than the real power. What is required is, that the registered horse power or nominal horse power should really represent the effective horse power, so that the numbers representing these quantities should be sufficient data for making a true comparison of the locomotive merits of different ships. *Any unit whatever* would answer this purpose, provided the nominal power and the effective power were represented in each separate case by one and the same number of such units. The only advantage that we can see in adopting the new notation, would be to diminish the number representing the indicated horse power, and so to raise the co-efficient C in the formula $\left(\frac{V^3 D^{\frac{5}{3}}}{\text{Ind. h.p.}} = C\right)$ to about three times the value it would otherwise have; and to bring the nominal and real horse powers to coincide to within one-third of the whole amount in excess or defect. Whether it is worth while to unsettle the present system merely to adopt *such an improvement*, we leave our readers to judge. It appears to us that Mr. Atherton would have done more service to

science, and would have put the committee on a better track, had he brought his experience and his means of procuring information from engine makers to bear upon the question of establishing some such relation between the proportions of the several parts of the engine *and of the boilers*, as to deduce a rule for the calculation of nominal power which should be at the same time the effective power of the engine.

As to Mr. Atherton's proposed unit, it seems to us to be a matter of perfect indifference whether it be adopted or not. The real desideratum remains as much a desideratum as ever.

Such, it appears to us, is the present state of this question, so much agitated of late by Messrs. Atherton and Henderson. Such, as we have endeavoured to faintly point out, is the nature of the investigations which it is incumbent on the newly-appointed Committee of the British Association to pursue. In conclusion, we would again express our opinion that they will best serve the cause of science by keeping a broad and well-defined distinction between the scientific objects sought to be attained, and any legislative enactments which may have for their end to compel the shipowner not to exceed a certain specific limit in the loading of his ship.

THE SALFORD ROYAL MUSEUM AND LIBRARY.

Several weeks have lately been occupied in considering the plans, and making the necessary arrangements for building the new south wing. In reply to the architects' advertisement, tenders from several of the principal builders in Manchester and Salford were sent in, all of which, however, were found to greatly exceed the estimated cost; and it became necessary to give the architects (Messrs. Travis and Mangnall) directions to make several alterations, and to take out much of the extra ornamental stonework over the windows and parapet, so as to reduce the cost, without at the same time sacrificing any of the essential details of the plan first adopted. By this change the new wing will be made nearly uuiform with the present wing, retaining, however, the new entrance-door and corridor. The tender of Mr. G. Harrop, Ellesmere Works, Chester Road, the builder of the Free Trade Hall and Mechanics Institution, to complete the whole work for the sum of £2,552, has been accepted, and there is every reason to believe that he will be able to accomplish the work, and give up the building into the hands of the committee, within the time specified in his agreement, so that, very early in the spring, the rooms may be in a fit state for the committee to commence casing and filling with the objects they may be able to exhibit during the summer of the ensuing year. In what manner all the rooms will be filled it is as yet rather premature to state, at least with any degree of certainty; but, for the present, the intention is mentioned of reserving the large upper room for an exhibition which shall possess a local character, having sufficient novelty to secure a large amount of public interest.

The ground floor room it is intended to divide into two, by a partition in the centre, so as to reduce the room to a more convenient and suitable size; and it will be hung with engravings, drawings, and small paintings. The museum already possesses a large collection of engravings, many of which are framed and glazed; but to add to these and give them greater interest, Mr. Alderman Agnew has promised to render most valuable and efficient aid, by donations and loans from his extensive emporium of art. The new corridor, with the entrance, will form a chaste architectural feature in the new wing, and will be most admirably suited to the display of casts from the antique, and statuary; and the basement room will most likely be fitted up for the geological collection (which will be removed from its present room, as that room will be required for the lending library), and for models of machinery, works, and other large objects. It will be apparent that by this enlargement of the museum building, the room for the display of objects will be more than doubled; and without great exertions on the part of the executive committee, and a large measure of support from the public in donations of objects, which it is trusted will be given, their efforts will be marred, if not altogether unsuccessful, in making an attractive and satisfactory exhibition for 1857. In addition to the building of the new wing, it is intended to pull down the present old and dilapidated portico on the east point, and to build another after the design of Mr. Walters, architect, Manchester. This design is of the Doric order of architecture, and will be entirely of stone. It shows four fluted columns, with a broad flight of steps approaching from the front only. The entrance-door will be widened to eight feet, and the vestibule made to correspond and harmonise with the architectural details of the new portico. This will be an additional expense, but a decided improvement, and prove a great convenience, especially at holiday times, when the visitors throng into the building at the rate of 3,000 in the hour.

The general progress of the library and museum, as evinced by the returns which, since its commencement, have so frequently been laid before the public, forms the best evidence from which to estimate the amount of moral aid which it must have rendered to the cause of the improvement and education of the working classes.

It now possesses an excellent library of modern literature, to the extent of 18,000 volumes, and has issued the large number of 410,000 of its volumes to the readers who daily frequent the reading-room, and it is most gratifying to know that this circulation has not been made up of light and trashy reading, as the returns enable us to show that whilst even less than one-third of the books belong to novels and light literature, and about the same proportion to general literature, the best and largest portion belong to history, biography, science, and art, and with the higher branches of literature. It has also been found, from taking the last three years into consideration, that about 400 readers frequent the reading-room daily. The library has been materially increased during the present year, and much attention has been paid to that department which is allowed to circulate to the homes of the people. The appreciation of this library is far greater than had ever been thought possible when it was first established, and the demands made upon its 5,500 volumes are almost equal to its entire circulation every month, and now make a total of 105,000 volumes issued since it opened. A single examination of its returns is sufficient to prove the amount of interest they possess, and the measure of the improvement which is gradually taking place in the taste for reading among its 2,300 borrowers.

The classification of the issues shows that three-fifths of the borrowed works are light and pleasant tales, novels, and romances, and that the remaining two-fifths are works upon history and other sound books. It appears that nine-tenths of the privileged borrowers are working people, or at least belonging to the working classes; that three-fifths of them are at the hopeful period of life for improvement and self-culture, being under 30 years of age; that one-fifth of the entire number are young females, and 150 are soldiers of the 25th Regt. now stationed at Salford-barracks. Such is a bare abstract of the returns from this active and popular free library.

The visitors to the museum are so numerous, and one day so much like another, that it is a fair and unexaggerated average estimate to say that about 2,000 people visit its rooms every day in the year.

DECAY OF STONE.

Mr. H. H. Burnell, in a letter to the *Times*, says:—

"It may be useful to invite attention to the method which has for some time past been adopted by the French to remedy this evil, and the more so because it has been employed at the Louvre, Notre Dame, and in other important works, with apparent success, up to the present time,—I allude to the application of the silicate of potash. Its manufacture and use may be briefly described as follows:—2¼ parts of silica (flint or clean sand) are fused with one part of potash; it is then dissolved by boiling (under pressure) in from eight to ten times its weight of water.

"The stonework of old buildings is thoroughly cleansed of all that might prejudice its absorbing qualities. Troughs hugged with clay are placed against the part of the building intended to be silicated, so as to collect the solution, which is applied with a syringe at intervals of three or four hours for about four days, or till the stone (when dry) ceases to absorb.

"It is considered desirable that this process should be repeated, but to a less extent, the following year. The colour of the stone is not materially changed, provided the absorption is tolerably equal and the silicalization effected by a sufficient number of applications of weak solutions, both of which conditions are necessary to success.

"The phenomena of induration is thus explained by M. Kuhlmann:—The carbonic acid of the atmosphere separates the silica from the potash, leaving it deposited in the pores of the stone, when, should the carbonate of lime be present (as in limestone), it combines with it and forms the silicate of lime, while the soluble salt—viz., the potash, is removed by the rain or other means. The price at which this work is undertaken in Paris is 1s. 3d. per superficial yard.

"I am aware that this process of silicalization is reported to have been tried without success at the Houses of Parliament, but, as it has been for some years past, and still is, employed advantageously in the instances I have named, as also in other important works in France, and has much philosophical reasoning in its favour, it may still be worthy of the consideration of those learned and interested in such matters."

AMPHIBIOUS CARRIAGES.

The following letter, as bearing on the question of metallic waggons and pontoons, is republished from the *United Service Journal*, at the request of Lady Bentham, who solicits "the insertion in the *Journal of the Society of Arts* of Sir Samuel's own ideas of the advantages which would accrue from the use of amphibious military baggage waggons, as already published in the *United Service Journal*, a publication not likely to be in the hands of mechanists." Her ladyship says: "It is but just that Mr. Francis should reap the profits of a skilful manufacturer, though not that he should be rewarded for the repeatedly published inventions of Sir S. Bentham. All the details of artillery amphibious baggage waggons were furnished by him to the Duke of Wellington, through his friend Sir Herbert Taylor."

To the Editor of the United Service Journal.

October 8, 1829.

SIR,—In looking over the copies of my letters to my friends in England, written during my stay in Russia, between forty and fifty years ago, I met with some accounts and drawings of an amphibious carriage I constructed in Siberia, which afforded me much convenience and pleasure during journeys of several thousand miles in that country. Conceiving that carriages constructed on a similar principle might become useful to travellers of the present day, and as no account of them has, I believe, ever been published, I herewith enclose extracts from such parts of my letters as relate to this subject, together with a drawing of the first amphibious carriage which I made use of.

This carriage was built during my first visit to Siberia, in 1781. Some years afterwards, whilst in the Russian service, having requested and obtained leave to exchange my regiment at Cherson, for a command in Siberia, consisting principally of two battalions, stationed one of them at Kiachta, on the frontiers of China, the other along the banks of the Irtish, above 1,200 miles from each other, the amphibious carriage presented itself to me as peculiarly suited to the enabling me to vary my route in passing from one to the other. I, accordingly, constructed two carriages of more simple form than the first, in which, while travelling post, I crossed several rivers without any stoppage at the banks, the horses continuing their course across the river, swimming whenever they got out of their depth.

On my return, in these carriages, from Siberia to Prince Potemkin's head-quarters at Jassy, previously to the taking of Ismailoff, the Prince, impressed with the importance of amphibious carriages in a military point of view, ordered a corps of chasseurs to be furnished with some of them, according to the general idea I gave of the requisite modifications, but as I then obtained leave of absence to visit my friends in England, I did not stay to direct the correction of some imperfections I observed in the only one I saw. I never returned to the service of Russia, and Prince Potemkin dying soon afterwards, it does not appear that any further steps were taken towards the adapting those vehicles to military purposes.

On my return to England I constructed a model of a military baggage-waggon on the same principle, which the late Duke of York saw at my house, together with some of my mechanical contrivances. On this occasion his Royal Highness suggested some improvements of his own, according to which a carriage was executed, and exhibited on the Thames above bridge, when his Royal Highness seemed determined to make use of this invention, but as I was at that time completely engaged in the duties of my office of Inspector-General of Naval Works, I neglected to draw any further attention to the invention. At a later period during my mission to Russia, the Emperor Alexander caused a carriage of this kind to be constructed, a model of which I suppose to be the one mentioned by Dr. Granville, in his account of St. Petersburg, as being deposited at the Admiralty. This carriage was several times tried on the Neva, but the Emperor wishing to see it further improved, so as to be adapted to the sick and wounded, and as I was at that time called home, I do not believe that the idea has been any further pursued.

The materials of which these several carriages were constructed were such as the different places afforded. The ribs were formed of ash, or other tough and flexible wood; the planking of the first was composed of two strakes, of three-tenths of an inch thick, placed diagonally, crossing each other at right angles, with a stratum of thin linen impregnated with tar between them. In other carriages, instead of the planking, the ribs were covered with raw hides, which, after being affixed, were smoked by burning sawdust under them for a week, a mode of preparing leather for boots, practised in some parts of Russia, instead of tanning. The amphibious baggage-waggon made according to the instructions of the Duke of York, was of tinned copper.

If these amphibious carriages were adapted for military purposes, supposing that all the carriages attendant on a regiment were constructed on the same principle, and that the number be the same as was in the Russian service, there would be in constant readiness a sufficiency of water conveyance to enable the whole of the *personnel*, as well as the *matériel*, to cross any river without further stoppages than the time necessary to take off the covers from the carriages, turn them upside down, and embark on board them; and so far from any addition being required to the usual number of horses, these carriages,

from the superior lightness of the construction, would actually need a less number than are usually employed. But even if the number of amphibious vehicles furnished means for no more than one-half of the *personnel* to pass a river at a time, they would be found exceedingly useful, and if similar means were adopted for passing the artillery in a state ready for immediate action, such an advantage might, on many occasions, be made productive of most important results.

I am, sir, your very obedient servant,
SAMUEL BENTHAM.

[Here follow three sketches of the ship-carriage in its several forms.]

Home Correspondence.

THE BESSEMER IRON.

SIR,—F. E. W., dating from Woolwich Arsenal, gives in the *Society of Arts Journal* the first detailed account of experiments on forged iron produced by Mr. Bessemer's process which I have seen in print. The bar he describes is 2 inches wide and 5 inches thick. The bar alluded to in my letter in the *Times* of Sept. 9th, was seen by me and many others at Baxter-house at the experiments of Monday 7th. It was some 15 feet long, 2 inches wide, and bare half-inch thick. One end of it was bent round cold to a circle of 6 inches diameter, displaying considerable toughness, and being bent backwards, a piece was broken off, which was carried away by a friend of mine to experiment on. The fracture showed white and large grained crystals. I inquired where the iron was rolled, and was informed, at "Woolwich Arsenal," being first tilted to a "bloom."

I enclose a piece of the bar, which has been partly cut through and broken. The broken part is crystalline, the portion between the break and cut is laminated, as described by F. E. W. To the file the iron is perfectly soft, without "pins" or hard particles, and with the back edge of a penknife small filaments are easily removeable; these are mechanical indications analogous to those of charcoal iron. The quality apppears to be homogeneous, but the lamination shows mechanical separation of parts, that is want of solidity, or porosity. But, nevertheless, it takes a very beautiful polish. The chemical analysis is given by F. E. W., but it would have been more satisfactory had he given the comparative analysis of the other irons against which it was tested. Nothing is said of specific gravity—an important element.

In the breaking experiment Bessemer's iron proved crystalline, the other four were fibrous. It is, therefore, certainly very remarkable how closely the crystalline approaches to the samples of two of the best fibrous in strength, while it exceeds the other two. This is a very important matter, for granular iron is, for many purposes, preferred to fibrous, as for the tyres of railway wheels, wherein fibre laminates and treads out into strings, and is only endured in frosty climates, as Russia and Canada.

Those who have witnessed the casting of the ingots will have remarked that the blast which permeates the mass of molten iron is continued during the process of pouring out. In fact, it pours out, aërated like so much champagne, and is received in a cast iron mould, which tends to chill the mass on the outside and leave the centre reedy and hollow. Probably this plan has been adopted from its quality of showing the experiment rapidly, without having to dig the ingot out of the sand. The best plan has not yet been adopted for obtaining dense ingots. In castings, it is customary to let the metal rest before pouring out, and to cast with what is called a "head," squeezing out the air bubbles below, with weight of metal above. Even in brass this is done. But Mr. Bessemer's castings have hitherto apparently all been made so as to ensure the least density in the ingot. Globular pores appear to be squeezed flat in rolling, and to induce lamination, analogous to beating up small shot into a mass.

The experiment at Woolwich,—reheating a cooled ingot—does not seem favourable to the production of dense non-porous metal. Once set, it is probably difficult to close the pores in the interior of a mass, just as it is difficult to make a cool rivet fill a hole. The external part feels the influence of a blow or pressure, which does not get to the interior.

Probably, the best method would be, after allowing the metal to subside to cast it in heated moulds; to form a vacuum while subsiding, and to put the mass under pressure as soon as it may be set, and then transfer it to the hammer and rolls.

What is fibre in iron? In wood, fibre is a mass of strings held together by a gummy substance, while in a woollen cord the fibres are held together by twisting. Probably, then, fibre in iron may be produced by some intervening substance separating the iron into strings in the process of squeezing. We do not yet understand this matter. Granular iron is probably the same as fibrous, with the difference that the intervening substance in fibrous iron lies in one direction in strings, and in the granular in broken strings lying in all directions. Molten gold, silver, copper, and lead, are as homogeneous when cast as when wrought, though not so dense. Probably iron, pure, and absolutely free from any other substance, may ultimately be got to the same condition. These considerations open up the question of what is crystallisation in iron. Lamination is striation in sheets; fibre is striation in strings; crystallisation is striation in irregular network. In neither case is the metal homogeneous; and this opens up the question whether the crystallisation is caused by the molecular arrangement of parts of pure metal, or by the interposition of some other substance. A question to be solved by the chemist, possibly, with the aid of a powerful microscope. But I think it will be found that each separate crystal is pure soft iron. These views are the result of simple thought, without the means of verification at hand.

The great fact in Mr. Bessemer's process is, that in a clay colander he produces, without fuel, an intenser heat than has before been produced with fuel; and by a rapid operation, without manual labour, a result of malleable iron ten times the amount of what has hitherto been produced at considerable cost of fuel by a slow process.*

Since the process became public, I have been informed that an amateur chymist has performed it on a small scale by very simple implements. Running down four ounces of cast iron in a crucible, he poured it into the large bowl of a heated tobacco pipe, using the stem as blow-pipe, till the process was complete. Any of your readers can try this simple experiment.

But it is a fitting proceeding for the authorities in Woolwich Arsenal to exhaust the subject. Without getting ingots from Mr. Bessemer, they should take the ores direct, of various makes of iron, and

First. Reduce them by the ordinary process, and puddle them or refine and puddle them.

Secondly. Reduce them by the ordinary process, and run the iron out into Mr. Bessemer's clay colander and make it malleable.

Thirdly. Reduce them by the ordinary processes, and then with Mr. Bessemer's apparatus subject the iron to every variety of gaseous substance.

Fourthly. Reduce them by the ordinary process, and mix the iron with lime and other substances in Mr. Bessemer's apparatus.

Fifthly. Vary the length of time Mr. Bessemer's pro-

* Not really without fuel. The carbon is fuel to chemical, but not manufacturing apprehension.

cess is continued, from the first commencement of scintillation to a period as long as heat can be kept up.

Sixthly. Reduce the ores and mix them with all probable chemical substances in the ordinary furnace.

Seventhly. Provide for the subsidence of Mr. Bessemer's iron by slow process, keeping it fluid as long as may be desirable.

Eighthly. Press samples of each iron in dies to attain the maximum density.

"F. E. W." states that phosphorus and sulphur are found in Mr. Bessemer's iron in nearly the same proportion as in Blaenavon pig, from which it is prepared. Here are two indications of the course to be pursued—first, to ascertain whence come the phosphorus and sulphur—from the ore, the fuel, or the fluxes; secondly, if heat be not sufficient to expel them, what chemical additions are required to neutralise them.

When the experiments are complete, tabulate them, giving the chemical analysis, specific gravity, tensional strength, torsional strength, ductility, rigidity under compression, power of resisting atmospheric oxydation, and comparative cost of production. The last six conditions are the conditions of general utility.

It will not be creditable to us nationally, if our public establishment, our chief arsenal, does not work out this great problem of exhausting the subject of iron production, conversion, and modifications. An individual has at his own cost turned over a remarkable leaf in the great book of Nature, and literally, with "great labour and expense," given us a kind of Rosicrucian alembic, in which fire burns without fuel; and it is desirable that the national laboratory should advance more than *pari passu* with the individual manufacturers in the opening future, confirming or combating the statements which individual interests may be supposed to bias.

Since the first reading of the paper before the British Association, experiment proper there appears to have been none by Mr. Bessemer, but a mere repetition of duplicate meltings before the thronging curious and the thronging interested. I am now informed that a hammer is about to be erected on the premises—not a steam hammer, but an air hammer, *i.e.*, a hammer lifted indirectly by steam with a cam movement, and forced downwards by the elastic action of compressed air in addition to its own gravity. What is commonly called a steam hammer is not really so, but simply a gravitation hammer lifted by steam directly instead of indirectly. We shall thus get to the next stage in the process.

Belief in disinterestedness is not a weakness to which human nature is generally prone, and it would be but worldly wisdom in any one possessing the weakness of disinterestedness to deny it, and assume an interest if he have it not. If he cannot show an ostensible interest in any subject he may advocate, he will be suspected of a concealed one, for the world firmly believes that "nobody gives nothing for nothing." In advocating this new process of iron-making I am fortunately able to fall in with the world's views, having a very strong interest in it, generally as an advocate for the substitution of iron for timber in buildings, by sea and land, and particularly in the application of it to the construction of my own "Suspended Girder Rail," which will then be not merely as cheap, but considerably cheaper in first cost than the wasteful timber structures; and if the "semi-steel" of Mr. Bessemer turns out a true process, we shall obtain a safe, cheap, and really *permanent* way.

I am interested in another thing, in which I believe I am backed by the generally chivalrous spirit of the English nation, viz., that the inventor, who is our constant prop and stay—our watchman—vigilantly guarding us against falling into the condition of Chinese—should have fair play and ample remuneration.

If your readers will refer to the paper of Mr. Kenyon Blackwell, on iron manufacture, read before the Society of Arts, they will notice how very remarkably he hovers round the then undiscovered process of Mr. Bessemer in all his remarks on iron puddling:—

"In some of the largest iron-making districts of Great Britain, the production of one ton of wrought iron of inferior quality is only obtained by the consumption of nearly one-and-a-half tons of crude or pig iron."

"The defects in the boiling process are the following: the wear and tear in the puddling furnace which occurs in heating grey pig iron, particularly that of the more fluid descriptions, the slowness of the operation, and the amount of manual labour which it entails to produce good results."

"It appears desirable to introduce between the blast furnace and the puddling furnace some intermediate process, which, like that of the *mazéage* practised on the continent, shall sufficiently decarbonize the grey pig iron at a small cost in fuel and labour, and without entailing the enormous waste of the coke necessary, so as to enable it to be heated rapidly and without difficulty in the puddling furnace."

I have one more remark to make, not on the humanity—because it is considered bad taste in trade to talk of humanity and to savour of humanitarianism, anti-cruelty to animals, and that "sort of thing"—but on the mere score of political economy, what an important item it is in Mr. Bessemer's process to get rid of the necessity of employing human puddlers. To produce fuel and train a workman to the age of 20 costs a given sum. Puddlers are worn out at 40 years of age; other workmen last till 50 and 60. Therefore, the capital invested to "raise" a puddler is sunk and expended in 20 years, while the same capital expended on other workmen lasts for 30 and 40. Depreciation of human stock is a large item in puddling. I again beg to state that I am talking political economy and not humanity.

I am, &c.,
W. BRIDGES ADAMS.

Proceedings of Institutions.

ALMONDBURY.—A meeting was recently held in the National School-room, Almondbury, for the purpose of establishing a Mechanics' Institution. The attendance was good, and those present were the class of persons who will be more especially benefited by the establishment of such an institution. E. Eastwood, Esq., president of the Huddersfield Mechanics' Institution, presided, T. Mallinson, Esq., the expected chairman, being unavoidably absent.—The CHAIRMAN expressed his sympathy with the object of the meeting; spoke of the benefit he had received from the Huddersfield Mechanics' Institution; showed that as people became more educated they obtained more of the substantial comforts of this life; advocated a high rate of subscription rather than a low one; urged the necessity of proper and efficient teachers being obtained for the pupils; inculcated kindliness and unity; and concluded by pointing out the dangers that would arise if the Institution, instead of being a place of instruction, became a mere place of amusement.—Mr. F. CURZON, secretary to the Huddersfield Mechanics' Institution, considered all present had determined to give themselves and their labour to the Institution, and believing the rise of towns, as well as of individuals, was caused by energy, enterprise, and enthusiasm, called upon those present to exert themselves in forwarding an institution which would confer such a vast benefit on the village. He hoped they would make it a Working Man's Institution, and be proud of it as such; and concluded by urging them to be self-reliant, and not to depend upon any assistance but their own.—The Rev. L. Jones, the vicar of Almondbury, cordially concurred with the last speaker.—After a few remarks from Mr. P. H. D. Jones, the meeting was addressed by Mr. Barnett Blake, lecturer to the Yorkshire Union of Mechanics In-

stitutions. He showed how the intelligence, industry, and enterprise of the inhabitants had raised England above other nations; pointed out the necessity for individual and combined exertion to keep the country in the place it occupies; and gave several hints on the best method of managing the new Institution.—Mr. JOSIAH MELLOR moved, and Mr. JOHN RUSSELL seconded, a resolution approving the establishment of a Mechanics' Institution, and naming Messrs. Midgley, J. R. Sykes, J. Mellor, J. Taylor, R. Beaumont, W. Dickenson, and D. Lee, a committee to carry out the resolution, with Mr. G. S. Midgley, secertary *pro tem.*—The names of those desirous of becoming members were taken by Mr. Midgley, Mr. Curzon the vicar, and others, and nearly fifty names were enrolled. Votes of thanks were passed to the chairman, the speakers and the singers, and the proceedings concluded, shortly after half-past ten o'clock, by the Almondbury Glee and Madrigal Union (who had sung several glees during the evening, in a highly satisfactory manner) singing "God save the Queen," in which the audience heartily joined.

LEWES.—The Committee of the Mechanics' Institution, with a view of extending its usefulness, have expressed themselves desirous of establishing classes for affording instruction in various departments of learning, and have issued a circular to the members to solicit their co-operation, from which the following is an extract:—"The Institution being in union with the Society of Arts, its members may avail themselves of all the privileges of the annual examinations of that Society for granting 'Certificates of Merit;' and the Committee hope that such a public recognition of intellectual attainments will greatly increase the number of students among their members. It will be impossible to organize any arrangements without knowing to what extent the Committee may rely upon the co-operation of the members, either as teachers or students; I am therefore instructed respectfully to solicit your assistance in attaining so desirable an object. For the purpose of ascertaining how far the proposal is likely to meet with your sanction and support, the Committee have prepared the accompanying list, and respectfully request you will denote those which you are disposed to join, and state in what capacity." The subjects for instruction in which it is proposed to establish classes, are the following:—Grammar, Geography, Rudiments of Arithmetic; French and other Languages; Geometry, Algebra, Mechanical Drawing; Drawing; Natural Philosophy, Physics; Natural History, Botany; History, General Literature; Chess Conversazione; Vocal Music.

PATENT LAW AMENDMENT ACT.

APPLICATIONS FOR PATENTS AND PROTECTION ALLOWED.

[*From Gazette, September 12th*, 1856.]

Dated 9th June, 1856.

1371. William Smith, Hastings—A material for the destruction of flies, gnats, and other insects. (A communication.)

Dated 16th July, 1856.

1675. David Bowlas, Reddish, Lancashire—Improvements in "throstles," and doubling frames for spinning and doubling cotton and other fibrous materials.

Dated 25th July, 1856.

1765. George Spencer, 6, Cannon-street West—Improvements in the couplings of feed pipes of locomotive steam engines and tenders. (A communication.)

Dated 21st August, 1856.

1951. Joseph Hacking and William Wheeler, Clitheroe, Lancashire—Improvements in the mode or method of winding, warping, sizing, and beaming cotton, woollen, linen, or other yarns or threads, and in the machinery or apparatus employed therein.

1953. William Akroyd and John Thompson, Halifax—The manufacture of carpets or other fabrics.

1955. Thomas York, Wolverhampton—A new or improved safety valve and low-water indicator for steam boilers.

1957. William Edward Newton, 66, Chancery-lane—Improvements in pumps for raising water. (A communication.)

Dated 22nd August, 1856.

1959. Thomas John Chipp and Richard Bitmead, Soho—Improved apparatus for drilling and boring.

1961. Charles Durand Gardissal, 10, Bedford-street, Strand—A new or improved rotary engine. (A communication.)

1963. Samuel Jay and George Smith, 246, Regent-street—Improvements in ornamenting or trimming articles of outer attire, such as dresses, mantles, bonnets, and the like.

Dated 23rd August, 1856.

1965. Philippe Benoist, 7, Rue de Lancry, Paris—An improvement in the construction of stereoscopes.

1967. John Henry Johnson, 47, Lincoln's-inn-fields—Improvements in stocking looms. (A communication.)

1969. William Racster, 28, Francis-street, Woolwich—Improvements in apparatus for regulating the supply of gas.

1971. Alexander Moses, Cannon-street-road East—Improved machinery for propelling vessels on water.

1973. James Wadsworth, Hazelgrove, near Stockport—Improvements in the ventilation of mines, and in removing noxious gases or vapours from places in which they accumulate or are generated, and in machinery or apparatus applicable to and to be used for such purposes.

Dated 25th August, 1856.

1975. Hugh Dickie, Girvan, Ayr, N.B.—Improvements in machinery or apparatus for cutting or shaping wood or other substances.

1977. William Webb, Wilson-street—An improvement in reclining chairs.

1979. Thomas Marples, Derby—Improvements in corn mills.

1981. Henry Bessemer, Queen-street-place, New Cannon-street—Improvements in the manufacture of iron and steel.

Dated 26th August, 1856.

1983. John Perry, 14, Great Portland-street—Improvements in photography.

1985. William Frederick Bush and William Hewitt, Bristol—Improvements in machinery or apparatus for grinding grain.

1987. Charles Carey, the Parade, Harleyford-road, Vauxhall—Improvements in shower baths.

1989. James Earl of Caithness, Barrogill Castle, Caithness, N.B.—Improvements in cutting or shaping stone and other substances.

1991. Richard Williams Vivian, Camborne, Cornwall—Economizing the consumption of fuel.

Dated 27th August, 1856.

1997. Thomas Lees, Stockport—Improvements in lubricating parts of steam engines, and in apparatus and machinery to be applied for that purpose.

1999. Alfred Vincent Newton, 66, Chancery-lane—An improvement in projectiles for cannon. (A communication.)

2001. Israel Colbeck, Batley, Yorkshire—Improvements in machinery for tearing rags, adapted particularly for shoddy or artificial wool.

Dated 28th August, 1856.

2004. Charles Durand Gardissal, 10, Bedford-street, Strand—A new manufacture of artificial fuel. (A communication.)

2006. Bernard Augustus Grautoff and Charles Henry William Albrecht, Lime-street-square—Improvements in the construction of pressure and vacuum gauges. (A communication.)

2008. Cæsar Heilmann, 22½, Milk-street, Cheapside—Improvements in furnaces of steam boilers.

Dated 29th August, 1856.

2010. John Avery, 32, Essex-street, Strand—Improvements in bellows. (A communication.)

2012. John Randolph Sees, New York, U.S.—Improved apparatus for heating the feed water of steam boilers.

INVENTIONS WITH COMPLETE SPECIFICATIONS FILED.

2033. Lazarus Simon Magnus, 3, Adelaide-chambers—Improvements in the manufacture of coke. (A communication.)—1st September, 1856.

2103. George Tomlinson Bousfield, Sussex-place, Loughborough-road, Brixton—An improvement in flying or roving frames. (A communication.)—9th September, 1856.

WEEKLY LIST OF PATENTS SEALED.

Sealed September 12th, 1856.

602. William Bramwell Hayes.
627. James and William Rice.
636. John Mitchell.
637. Thomas Palmer.
638. Robert Thomson.
655. John Davie Morries Stirling.
667. William Charles Theodore Schaeffer.
743. William Ward.
759. William Muschamp.
771. Charles Jean le Mélorel de la Haichois.
809. Frederick William Kitson.
839. Ephraim Morris.
871. George Jackson.
885. George Davies.
965. Thomas Jeacock.
1395. John Stenhouse.
1503. Henry Waller.
1533. Henry Brown and Job Bartlett.

PATENTS ON WHICH THE THIRD YEAR'S STAMP DUTY HAS BEEN PAID.

September 9th.

2135. Moses Poole.

September 10th.

2166. Christopher Nickels and Ralph Selby.

September 12th.

2116. Henry Dubbs.
2117. Adolphus Sington.
2118. Alexander Allan.
2331. James Hall Nalder and John Thomas Knapp.
2409. John Norton.

September 13th.

2136. George Spencer.